Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2015

Biology

Higher level

Paper 3

13 pages

Subject Details: Biology HL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options **[2 × 20 marks]**.
Maximum total = **[40 marks]**

1. A markscheme often has more marking points than the total allows. This is intentional.

2. Each marking point has a separate line and the end is shown by means of a semicolon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are underlined are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

Option D — Evolution

1. (a) as brain mass increases life span increases / positive/direct relationship/correlation **[1]**

(b) other placental mammals **[1]**

(c)

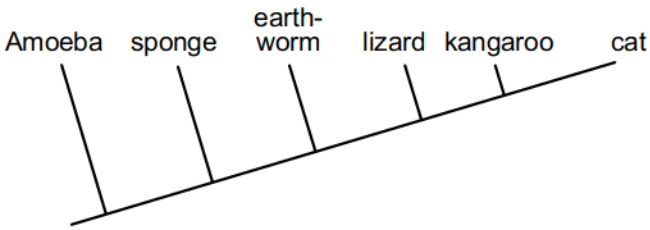
	primates	***marsupials***
a.	larger range of brain mass	(smaller);
b.	(generally) greater brain mass	(generally less);
c.	larger range of life span	(smaller);
d.	(generally) with greater life span	(generally with lesser life span);
e.	both with positive relationship between brain mass and life span;	
f.	both overlap (with the primates higher);	

[3 max]

Do not accept answers stating only numerical values without comparative wording.

(d) a. larger brain size allows for higher intelligence/better cognition/more complex brain functions;
b. more efficient food finding / escape from predators;
c. longer life span favours parental care / survival for more reproduction;
d. (these advantages) favour natural selection which leads to evolution; **[2 max]**

2. (a)



[3]

*Award **[1]** for the correct position of any two organisms.*
*Award **[1 max]** if the correct order is reversed horizontally (ie from cat on the left to Amoeba on the right).*

(b) a. both lead to formation of new species;
b. allopatric occurs in a different geographical area whereas sympatric occurs in the same geographical area;
c. allopatric have physical barriers whereas sympatric have behavioural/temporal barriers (that reduce gene flow);
d. both lead to genetically isolated populations/gene pools; **[2 max]**

(c) a not all organisms can be defined in this way / does not take into account hybrids/ microorganisms/plants;
b. (even if able to interbreed) may have differences in DNA/protein;
c. does not apply to bacteria/other organisms that reproduce asexually;
d. in sympatric/allopatric isolation members of the same species do not interbreed;
e. (in some species) significant differences in morphology can occur within the same species *eg*: sexual dimorphism/metamorphosis/ring species; **[2 max]**
Accept any other correct answer.

3. a. used to calculate allele frequencies (in a population);
b. two allele frequencies in a population are represented by p and q;
c. total frequency of the two alleles/p + q is 1;
d. probability of inheritance of each combination of alleles can be shown with a Punnett grid /

	p	q
p	p^2	pq
q	pq	q^2

;

e. $p^2 + 2pq + q^2 = 1$;

assumptions: **[3 max]**
f. random mating;
g. constant allele frequency;
h. no selective advantage of one allele over other;
i. no natural selection;
j. no mutation;
k. large population;
l. no emigration/immigration; **[6 max]**

Option E — Neurobiology and behaviour

4. (a) *bees fed with ethanol*:
5.9 (%); *(allow answers in the range of 5.8 (%) to 6.0 (%))*
bees fed without ethanol:
1.3 (%); *(allow answers in the range of 1.2 (%) to 1.4 (%))*
(both needed) **[1]**

(b) a. without alcohol (antennation starts at a high level and) decreases with time;
b. with alcohol, the value (starts low and) very slowly increases;
c. the values of both groups become very similar with time; **[2 max]**

(c) a. (time spent) walking is greater in bees without alcohol (than alcohol);
b. (time spent) grooming is greater with alcohol (than without alcohol);
c. the end point difference is greater in walking;
d. (time spent) walking increases whereas grooming decreases for both groups of bees; **[2]**

(d) a. (hypothesis is supported as) alcohol decreases antennation at the start of the experiment;
b. (hypothesis is supported as) alcohol increases begging at the start;
c. begging time is more variable/less significant differences with alcohol (so less clear than in antennation);
d. (hypothesis is supported as) the effect of alcohol on social behaviors becomes less distinguishable over time (with the effect of sucrose) / *OWTTE*; **[3 max]**

5. (a) a. when the population of *Daphnia*/water fleas is high, the bluegill selects the largest sizes;
b. when the population is low, the bluegill eats any size;
c. thus maximizes energy input for minimum energy expenditure / *OWTTE*; **[2 max]**

(b) a. *excitatory*: nicotine / cocaine / amphetamines / other drugs;
b. *inhibitory*: benzodiazepines / alcohol / THC / other drugs; **[2]**

(c) a. named animal;
b. description of learned action allowing a more flexible response that improves health/survival/reproduction; **[2 max]**

eg:
a. chimpanzees;
b. poking sticks in the wood increases chances to get more food/termites/insects;

a. blue jays;
b. avoidance of certain bad taste / poisonous insects prevents them from being sick/poisoned;

a. hedgehogs;
b. running across roads instead of rolling up when vehicles approach more likely prevents them from being killed;

Accept any other verifiable examples.

6.

	sympathetic	parasympathetic
a.	both are controlled in the brain/brain stem/part of the ANS;	
b.	both (usually) have opposite actions / sympathetic is excitatory and parasympathetic inhibitory/returns to rest / *OWTTE*;	
c.	both affect hormone secretion/homeostasis;	
d.	uses adrenaline/noradrenaline	uses acetylcholine:
e.	causes vasodilation of blood vessels in the heart	vasoconstriction of blood vessels in the heart;
f.	increases heart rate	slows down heart rate
g.	diverts blood flow to heart	diverts blood flow from heart;
h.	causes contraction of (radial) muscles in eye (attached to the pupil/iris)	causes contraction of (circular) muscles in eye (attached to the pupil/iris);
i.	dilates pupil/iris	contracts pupil/iris;
j.	causes vasoconstriction (of blood vessels in the gut)	vasodilation (of blood vessels in the gut);
k.	reduces blood flow to the gut	increases blood flow to the gut;

[6 max]

Answer does not need to be in a table format.
*Award **[4 max]** where complete marking points are present but there is no explicit comparison.*

Option F — Microbes and biotechnology

7. (a) (i) (state) 7 **[1]**

(ii) a. physical barriers prevent spreading;
b. distribution of flowering plants (which affects the bee distribution);
c. different strains of bees with resistance to different viruses/different levels of resistance;
d. different amounts of the vector that transmits the virus / different levels of treatment of viruses by beekeepers;
e. random spreading of the virus / different densities of bee (populations in different states); **[2 max]**

(b) a. state 1 has all five viruses but state 4 only three;
b. both states have viruses A, D and S;
c. state 1 has more infected with virus S;
d. state 4 more/100 % with virus A and D;
e. A and D do not reach 100% in state 1 while both A and D reach 100 % in state 4; **[2 max]**

Accept any other valid comparison.

(c) a. virus B present in 6 states/less states than D;
b. virus D present in 9 states/all states;
c. virus D infects higher percentage of colonies than virus B; **[2 max]**

(d) a. state 5 as it only has two viruses (although in all colonies);
b. state 9 as it has all five viruses but in lower quantities;
c. state 2 as it only has three viruses (very little B); **[1 max]**

8. (a) a. viral vector modified to include healthy gene;
b. virus is taken up by cells;
c. inserts normal gene into chromosome;
d. white blood cells / bone marrow/other cells replaced into patient; **[2 max]**

(b) a. *Aspergillus* sp: production of miso / soy sauce / food preservatives; } *(allow other verifiable use)*

b. *Saccharomyces sp*: production of beer/wine/bread/other alcoholic drink; **[2]**

(c)

		chemoautotrophs	***photoheterotrophs***
a.	energy sources:	chemical reactions	light;
b.	carbon sources:	inorganic substances / CO_2	other organisms / organic substances / (some) C/carbon fixation;
c.	food production:	both can produce their own food;	

[2 max]

*Award **[1]** for each complete correct line.*

9. a. pathogens/toxins may be released/contaminate drinking water;
b. (saprotrophic) bacteria live off sewage;
c. decrease dissolved oxygen/DO / increase the oxygen demand/BOD;
d. animals/other (aerobic) organisms may die;
e. decomposition causes increase in ammonia/nitrates/phosphates/CO_2;
f. high levels of nitrate/phosphate can stimulate algal growth/blooms / eutrophication;
g. block light for other algae/plants below;
h. which die and decompose, releasing more nutrients;
i. promote more algal growth; **[6 max]**

Option G — Ecology and conservation

10. (a) (site) 1 **[1]**

(b) a. (CFU of) *E. coli* on mats remains higher/almost 10^2 more than in the water samples;
b. over time in mats the values do not change much while in water they decrease/disappear; **[2]**

(c) a. excess nitrogen from fertilizers as run-off from agricultural lands;
b. excess organic matter from sewage overflow;
c. change in temperature/global warming;
d. change in pH; **[2 max]**
Do not accept a general statement of minerals or fertilizers in the water.

(d) a. *Cladophora* provide a habitat for *E. coli* so more *E. coli*/CFUs (in mats);
b. *Cladophora* provide more food for *E. coli* so more *E. coli*/CFUs (in mats);
c. *Cladophora* in mats are dead and decomposed by *E. coli* / *Cladophora* in water are alive so not decomposed by *E. coli*; **[2 max]**

11. (a) (i) a. 380 / 64;
*Award **[1]** for the correct calculation of the numerator **or** the denominator*
b. 5.94; *(accept 5.9)*
*Award **[1]** for correct answer.* **[2]**

(ii) a. there is greater species diversity/richness than a year ago / diversity/richness has increased;
b. the community is showing signs of stability / succession has progressed; **[2 max]**

If the answer in (a)(i) is smaller than 4.3 allow ECF and use the following markscheme.

a. there is less species diversity/richness than last year / diversity/richness has decreased;
b. the community is less stable / succession has regressed;

(b) tundra **[1]**

(c) a. reserves protect the species genetic diversity;
b. species remain (adapted) in own habitat with natural behaviour;
c. species interact with each other which helps to conserve the whole ecosystem;
d. difficult to manage (due to size);
e. predators/poachers/disease difficult to control; **[2 max]**

12.

	name	**brief description**	**limitations**
	a.	b.	c.
example 1	echosounding;	bounce sonar off shoals of fish;	does not work at depths / need sample to identify fish;
example 2	capture–mark–recapture;	capture and mark fish, release, recapture and count to calculate population;	feasible in lakes but not open sea (due to migration);
example 3	collection of data on fish catches;	record numbers and age distribution of catches;	problems with sampling/ records/interpretations;

challenges:

d. maintain fish as an important food source for humans/other animals;
e. a sustainable yield means not overfishing an area/not causing a decline in the population/ not catching faster than the fish can replace themselves / *OWTTE*;
f. pollution threatens world fish stocks/habitat;
g. disagreements as to what is a sustainable population;
h. disagreements in the collection of data of population sizes;
i. requires international cooperation to define conservation measures/regulations/quotas;
j. difficult to reinforce/control regulations / monitor practices / *OWTTE*; **[6 max]**

*Award **[4 max]** if only challenges addressed.*

Named method could be any of the three examples given above but the description and limitation must be based on one named method only.

Option H — Further human physiology

13. (a) (i) 27 (years) **[1]**

(ii) a. closing/inflammation of the bronchial tubes / difficulty breathing / wheezing / shortness of breath;
b. gas exchange is reduced;
c. lower tidal volume; **[2 max]**

(b) (exercise provokes asthma symptoms) in a high percentage in all 3 categories / *OWTTE*; **[1]**

(c) a. as body weight increases, so does asthma severity;
b. normal body weight has highest percentage of mild asthma;
c. obese has highest percentage of severe asthma;
d. exercise provokes asthma in all weight categories;
e. overweight falls in between obese and normal / closer/similar to obese (in some categories); **[2 max]**

(d) a. severity of asthma likely to increase;
b. exercise likely to provoke slightly more symptoms;
c. obesity likely to have slightly higher (median) duration; **[2 max]**

14. (a) a. *I*: microvilli;
b. *II*: tight junction / plasma membrane; **[2]**

(b)

	gastric juice	***pancreatic juice***
a.	highly acidic/contains HCl	more alkaline/contains bicarbonate;
b.	enzymes include pepsin/pepsinogen/rennin	enzymes include amylase/lipase/ carboxypeptidase/trypsinogen;
c.	contains mucus (for protection)	no mucus;
d.	both contain proteases/water;	

[2 max]

(c) a. correlations have been found between smoking and increased risk of CHD;
b. nicotine causes vasoconstriction and raises blood pressure / increases heart rate;
c. correlates with higher risks of plaque formation/atherosclerosis/blood clotting;
d. difficult to identify causes as many factors involved in CHD; **[2 max]**

15. a. helps regulate blood glucose level / converts glucose to glycogen and back;
b. prevents excess glucose that could damage cells / lack of glucose could limit cell growth/activity / *OWTTE*;
c. stores/recycles iron;
d. stores vitamin A/vitamin D;
e. synthesizes plasma proteins/cholesterol;
f. provides essential substances for cell growth/hormone production;
g. detoxifies substances / protects the body from damage from toxic substances (as alcohol);
h. breaks down erythrocytes/hemoglobin;
i. production of bile for digestion (of fats);
j. (production of bile) reduces build-up of bilirubin in the blood / prevents jaundice; **[6 max]**